489

367-0042

Instruction Manual

JOHN FLUKE MFG. CO., INC.

V. L. I.
Property

3-D-43

ELECTRONICS FOR INDUSTRY

FLUKE

MODEL 803/
AC/DC
DIFFERENTIAL VOLTMET

INSTRUMENTS / COMPONENTS

JOHN FLUKE MFG. CO. INC.
P. O. Box 7428 Seattle 33, Washington

October 25, 1961

MODEL 803/A4
AC/DC
DIFFERENTIAL VOLTMETER

803 3320 +m

803R

APPROVAL & PROCUREMENT RECORD

BASIC APPROVAL DATA FOR: NAVSHIPS 367-0042

TITLE: DIFFERENTIAL VOLTMETER
MODEL 803 AG

Approved by SupShip, Seattle, letter DLG/5600 Serial 254J-4715 of 7 September 1962.

CONTRACT OR ORDER	DATE APPLICABLE	VESSEL	QUANTITY OF MANUALS	BUILDING YARD
7-DLG-489 NObs 4248	9-12-62	DLG-21	4	PUGET SOUND BRIDGE & DRY DOCK COMPANY

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REMARKS:

803 AG

CERTIFICATION: DATE: 12 September 1962

It is hereby certified that the manual, NavShips 367-0042, provided under this contract, 7-DLG-504, has been approved by authority of basic approval data shown above.

David F. Smith
PUGET SOUND BRIDGE & DRY DOCK Co.
Naval Construction Administrator

V. L. I.
Property

ERRATA AND ADDENDUM

803/AG

INSTRUCTION MANUAL

This manual was originally intended for the 803RB Voltmeter only. However, the 803/AG Voltmeter is exactly the same as the Model 803RB except as follows:

1. The 803/AG is a cabinet rather than a rack model.

2. The 803/AG does not have a drip-proof panel.

MODEL 803R/B

ADDENDUM

WARNING. For maximum accuracy, the 500 volt reference supply must be calibrated against the Zener Reference with the range switch in the 500 volt DC position.

MODEL 803R/B - DC - AC DIFFERENTIAL VOLTMETER

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MODEL 803R/B DC - AC DIFFERENTIAL VOLTMETER

SPECIFICATIONS

AS A DIFFERENTIAL VOLTMETER

VOLTAGE RANGES:

	Input Voltage Range	Recommended Null Range	Input Impedance At Null	Input Impedance 1% Off Null
DC:	50-500	10-0-10	INFINITE	100M
		1-0-1	"	1000M
	5-50	1-0-1	"	1000M
		.1-0-.1	"	1000M
	.5-5	.1-0-.1	"	1000M
		.01-0-.01	"	1000M
	0-.5	.1-0-.1	"	1000M
		.01-0-.01	"	1000M
AC:	50-500	10-0-10	1M, 25 uuf	1M, 25 uuf
		1-0-1	"	"
	5-50	1-0-1	"	"
		.1-0-.1	"	"
	.05-5	.1-0-.1	"	"
		.01-0-.01	"	"

RESOLUTION:

	Input Voltage Range	Dial Resolution (Volts)	Meter Resolution (Volts)
DC:	50-500	.01	.005
	5-50	.001	.0005
	.5-5	.0001	.00005
	0-.5	.00001	.000005
AC:	50-500	.01	.005
	5-50	.001	.0005
	.05-5	.0001	.00005

ACCURACY:

DC: ±.05% of input voltage from .1 to 500V

±0.1% of input voltage or .00005V, whichever is greater from 0 to .1V.

AC: ±.2% of input voltage from .5 to 500V, reduced accuracy from .05 to .5V.

AS A VACUUM TUBE VOLTMETER

VOLTAGE RANGES:

	Input Voltage Range	Input Impedance
DC:	± 500	10M
	± 50	10M
	± 5	10M
	± .5	10M
	± 10 *	10M
	± 1 *	10M
	± .1 *	1M
	± .01 *	1M
AC:	0-500	1M, 25 uuf
	0-50	"
	0-5	"
	0-100 *	"
	0-10 *	"
	0-1 *	"
	0-.1 *	"
	0-.01 *	"

* Using Null Ranges

GENERAL SPECIFICATIONS

REFERENCE STABILITY:

±.01% for 25% change in line voltage

±.01% per hour after 1 hour warmup

AC TO DC CONVERTER FREQUENCY RESPONSE:

30 cps to 5000 cps

INPUT POWER:

150 watts at 117/234 volts, 50/60 cycles

SIZE:

Rack Model - 8-3/4" H x 19"W x 16" D overall
(15" D from mounting surface)

WEIGHT:

Rack Model - 33 pounds

PANEL:

Dripproof per MIL-T-945A

JOHN FLUKE MFG. CO., INC., P. O. BOX 7161, SEATTLE 33, WASH.

MODEL 803R/B

PRECISION DC - AC DIFFERENTIAL VOLTMETER

INSPECTION

This instrument has been thoroughly checked and tested before being shipped from the factory. Upon receipt of the instrument, inspect carefully for any damage which may have been incurred in transit. Reference should be made to the WARRANTY section of this instruction manual for the procedure to be followed if any shipping damage has occurred.

INITIAL OPERATION

Connect the instrument to a 105 - 130 volt, 50 - 60 cycle power source. It can be used with a 234 volt, 60 cycle power source by changing jumpers as indicated on the reference power supply board and changing the main fuse from 3a to 1.5a. Set the RANGE switch to the 500V DC position, the NULL switch to the VTVM position, all 5 voltage dials to zero, and then turn the OP-CAL switch to the ON position. The decimal lamps will indicate when power is applied. Allow the instrument to warm up for 5 to 10 minutes before making adjustments.

Adjust the VTVM, 10V, 1V ZERO potentiometer for zero meter deflection. Turn the NULL switch to the .01V position. Adjust the .1V, .01V ZERO potentiometer for zero deflection. Turn the NULL switch back to the VTVM position.

Calibrate the internal 500 volt reference supply by first turning the OP-CAL switch to the CAL REF position. Then hold the OP-CAL switch in the CAL ADJ position and adjust the ADJ CAL potentiometer for zero reading on the meter. Turn the OP-CAL switch back to the ON position when calibration is completed. The instrument is now ready for use.

TO MEASURE DC VOLTAGES

First determine the approximate value of the unknown voltage. With the RANGE switch set to the 500V DC position and the NULL switch set to the VTVM position, connect the voltage to be measured to the positive and negative binding posts. If the meter reads to the left, reverse the input connections. The positive binding post (red) on the instrument must always be positive with respect to the negative binding post (black) when making differential dc measurement since the internally generated voltage is always positive. A ground shorting link can be connected to either binding post depending upon the external circuit conditions. Always set the RANGE switch to the lowest range which will give an on-scale reading.

Now determine the precise value of the unknown voltage. Set the 5 voltage dials to the approximate voltage indicated on the meter. Be sure to observe the decimal lights. Then turn the NULL switch to the 10V sensitivity (full scale sensitivity) and trim the voltage dials for zero meter deflection. Then

turn the NULL switch to the increased sensitivities, always keeping the meter deflection zero by means of the voltage dials. Finally, when the NULL switch is in the .01V position the unknown voltage can be read directly from the 5 dials.

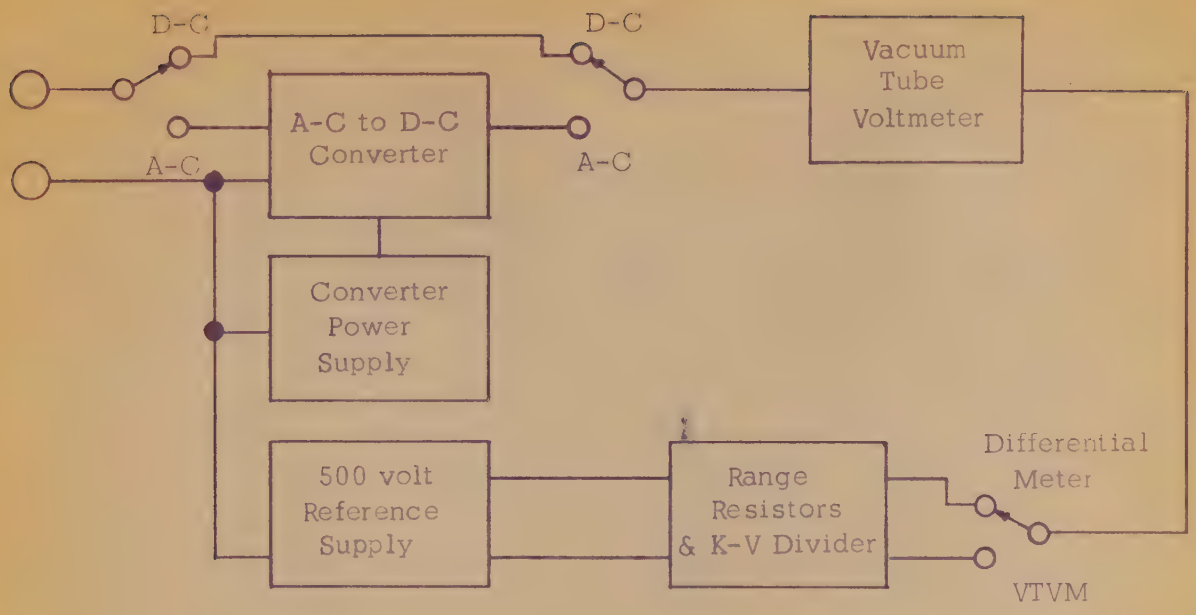
TO MEASURE AC VOLTAGES

AC voltages are measured in a manner identical to that used for dc voltages, except that the RANGE switch must be set to the ac ranges. A ground shorting link must always be connected to the negative binding post when making differential ac measurements, however. This is to reduce the effect of electric fields within the instrument.

TO OBSERVE EXCURSIONS OF A VOLTAGE ABOUT A NOMINAL VALUE

Set up the nominal voltage on the 5 voltage dials and observe the excursions directly on the meter on one of the 4 null ranges. Use recommended null ranges where possible. A right hand deflection of the meter indicates the voltage under observation has increased above the nominal value by the amount indicated. Note that the output of the converter always utilizes the basic 5 volt dc range, regardless of input voltage. This influences the sensitivity of the null ranges when making ac measurements. Therefore, the basic null sensitivity must be multiplied by a factor of 10 when measuring between 5 and 50 volts ac and by 100 when measuring 50 to 500 volts ac, as indicated by the null multiplier lamps.

It should be noted that most ac power sources are not especially amplitude stable. This is also true of most laboratory oscillators. The output amplitude of many oscillators is extremely sensitive to mechanical vibration and line voltage fluctuations for example. Under normal conditions the 803R/B does not introduce noise or variation in the reading.



803R/B BASIC BLOCK DIAGRAM

The Model 803R/B Precision DC-AC Differential Voltmeter operates on the basic principle of comparing an unknown voltage with an adjustable known voltage, and any difference between the two is indicated on a sensitive null detector. The circuit consists of 5 main elements which are:

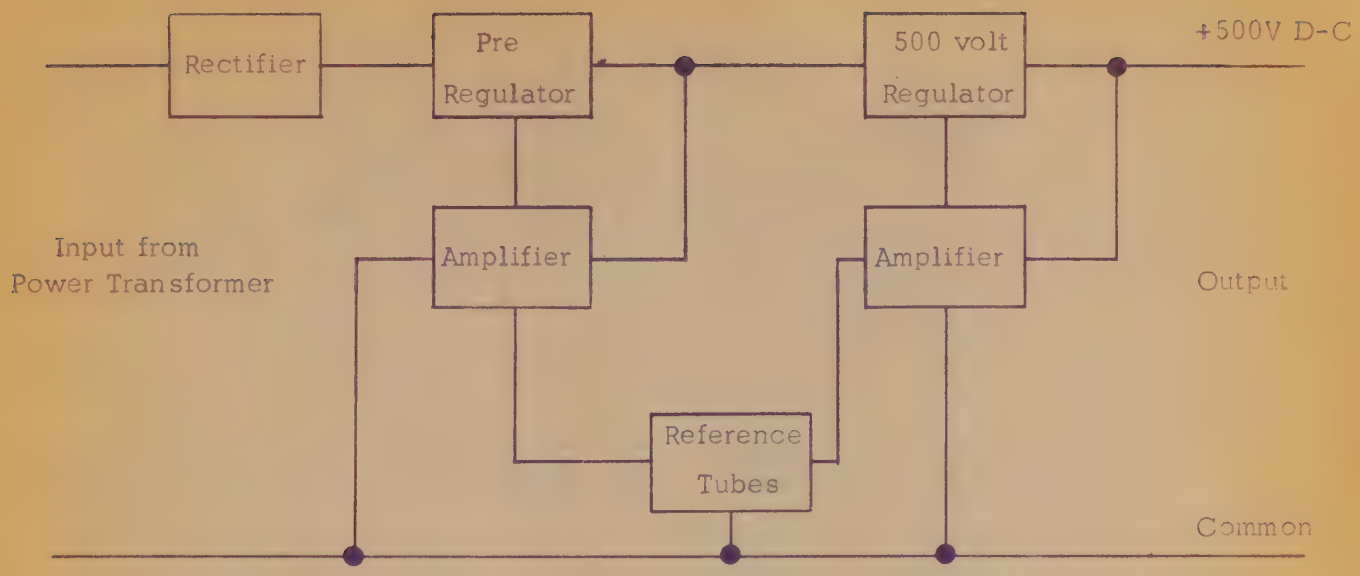
1. An extremely stable 500 volt dc reference supply, with a means for setting this reference to 500 volts ±.01%.

2. A network of range resistors for dividing the 500 volt reference down to three lower reference voltages of 50, 5, and 0.5 volts, and a precision 5-dial Kelvin-Varley divider for selecting an accurate, known portion of one of the four reference voltages.

3. A calibrated multi-range VTVM which is used both as a conventional VTVM for determining the approximate value of the unknown voltage and as a null detector for measuring the difference between the unknown voltage and the internally generated known voltage.

4. An ac to dc converter which is used for all ac measurements to convert an unknown ac voltage to an unknown dc voltage, which in turn is compared with the internally generated known dc voltage.

5. A well-regulated converter power supply which provides plate and filament power for the ac to dc converter.



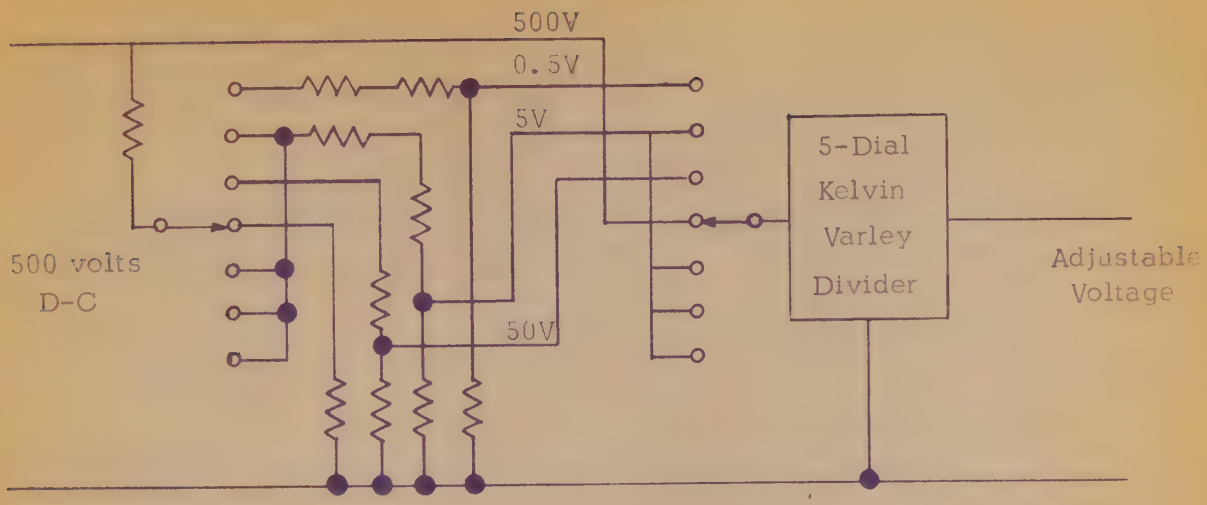
500 VOLT REFERENCE SUPPLY BLOCK DIAGRAM

The 500 volt reference supply is the source of the internally generated known dc voltage. Its basic elements are:

1. A pre-regulator which supplies approximately +625 volts dc to the main regulator.

2. A +500 volt dc regulator which supplies the reference voltage.

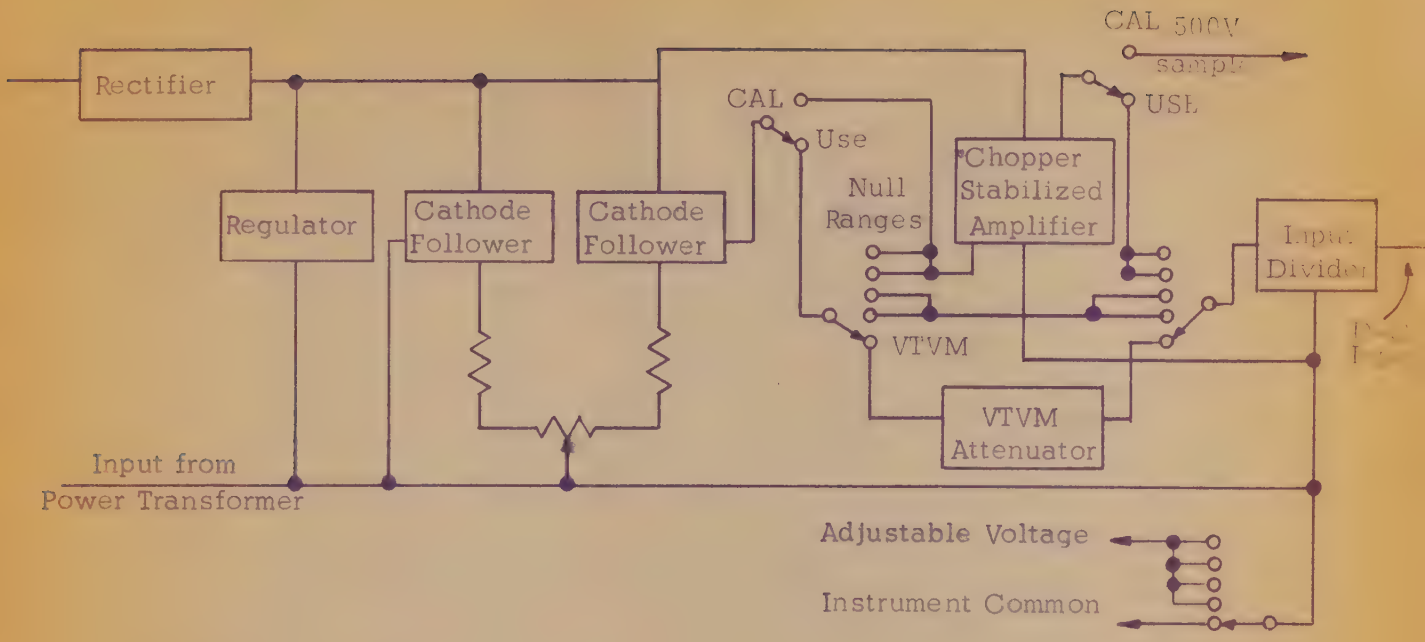
This supply is extremely well regulated, with the output changing less than .01% due to line voltage fluctuations or ambient temperature changes. A resistive sample string monitors the 500 volts and is calibrated to give an output exactly equal to the potential of a Zener reference source when the dc reference supply is 500 volts ±.01%. This supply should be calibrated after a warm-up period if precise measurements are to be made.



RANGE RESISTORS & K-V DIVIDER BLOCK DIAGRAM

The range resistors are utilized to provide four accurate reference voltages of 500, 50, 5, and .5 volts. The five-dial Kelvin-Varley divider is utilized to select an accurately known portion of one of the calibrated reference voltages. This then becomes the internally generated known voltage, which is compared with the unknown voltage. The accuracy of the Kelvin-Varley divider is maximum when the ratio of output voltage to input voltage is as high as possible. Therefore, it is best to make a precise measurement with the range switch in the position which results in the unknown voltage being as close to, but not exceeding, the maximum voltage allowable for that range.

The Kelvin-Varley divider is made of matched, precision resistors. If any of the resistors in the five-dial divider become defective, send the resistor value and serial number of the instrument to John Fluke Mfg. Co., Inc., where a record is kept of the exact values used in each instrument shipped. In this way a replacement can be obtained which will not upset the matching of the other resistors on the particular switch.



VTVM BLOCK DIAGRAM

The VTVM circuit is utilized for all measurements. Its basic elements are:

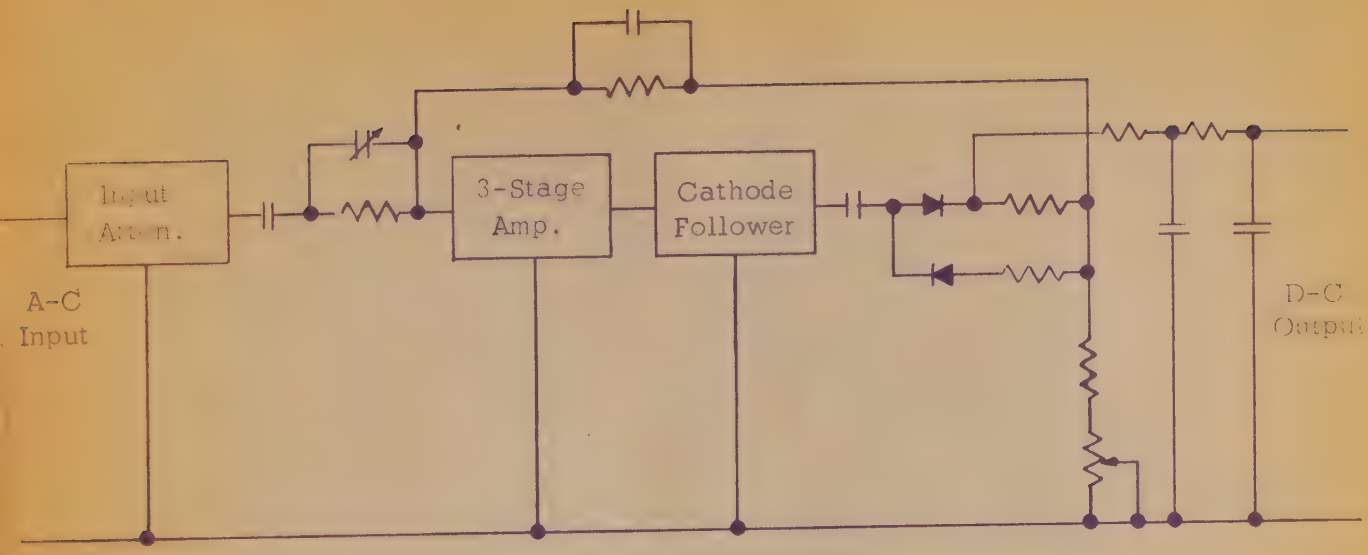
1. A simple +105 volt regulator which supplies plate power for the rest of the circuit.

2. A cathode follower type VTVM.

3. A chopper stabilized amplifier which is used in the two most sensitive null ranges.

4. Associated divider networks which are used for the various ranges and null sensitivities.

The common bus in the VTVM circuit is connected to the instrument common (negative binding post) when the null switch is in the VTVM position and to the internally generated known voltage from the Kelvin-Varley divider with the switch in all null range positions. Thus, at null, there is zero potential across the input divider and zero current flows in the input circuit. The cathode follower type VTVM has a basic full scale sensitivity of .5 volts dc. Therefore, a chopper stabilized amplifier with fixed gain is required to the .1 volt and .01 volt null ranges.



A-C TO D-C CONVERTER BLOCK DIAGRAM

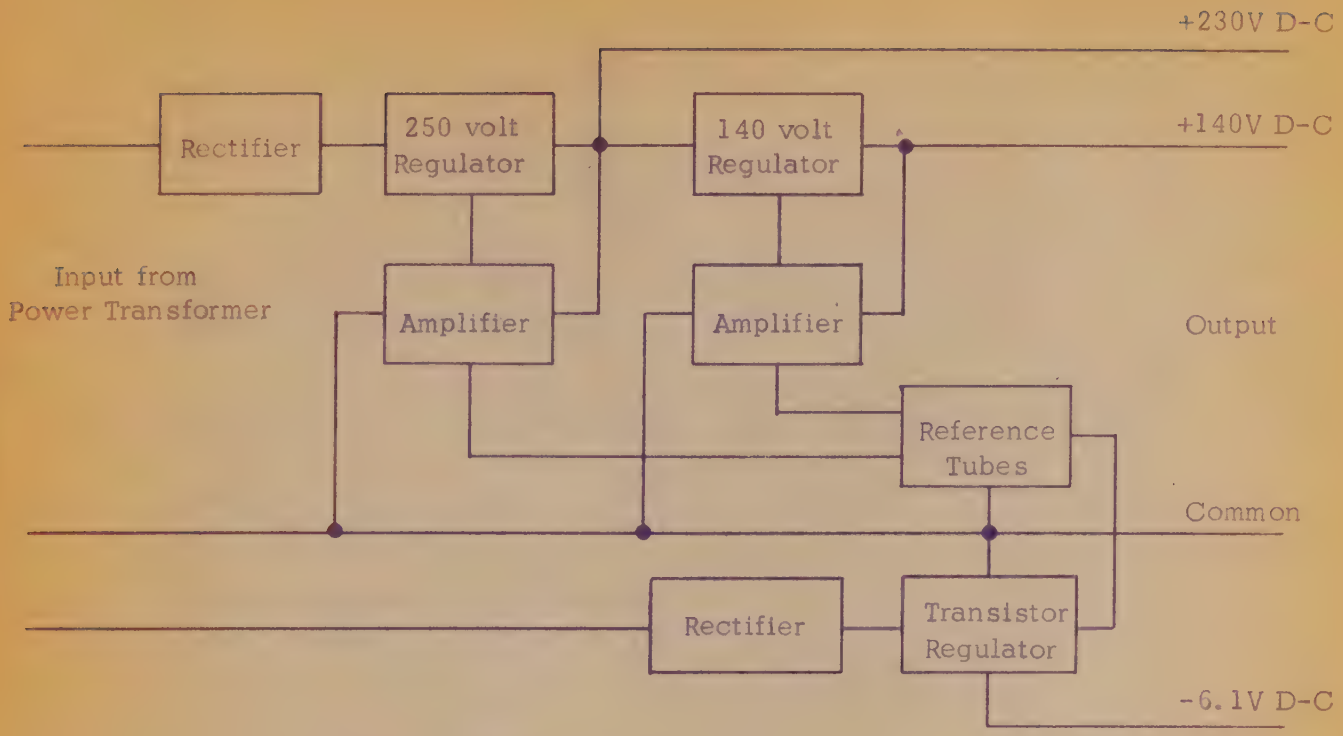
The ac to dc converter is utilized for all ac measurements. Its basic elements are:

1. A precision input attenuator which allows the converter to operate at the same voltage level for all three ac ranges.

2. A high-gain three-stage feedback amplifier with a cathode follower output.

3. A half-wave silicon diode rectifier and filter network which provides a dc output.

The ac to dc converter gives a dc output of 5 volts for an ac input of 5 volts rms. The converter always operates between 0.5 volts and 5 volts because of the input attenuator. The closed loop gain of the amplifier is approximately 2.5 and the open loop forward gain is centered about 26,400. The gain of the amplifier is flat in the mid-band and is down 3 db at 30 cps and 5 kc. The primary feedback is full-wave and is a function of the current through the silicon diodes. The dc output is proportional to the average value of the ac input wave, and is calibrated to indicate the rms value.



CONVERTER POWER SUPPLY BLOCK DIAGRAM

The basic elements of the converter power supply are:

1. A +230 volt dc regulator which supplies plate power for the high-gain stage and cathode follower in the converter.

2. A +140 volt dc regulator which supplies plate power for the two lower-gain stages and all screen power in the converter.

3. A transistor regulator which supplies filament power of -6.1 volts dc for all filaments in the converter.

It is important that the plate supply for the output stages in the converter and that the converter filament supply be well regulated to avoid undesirable transients due to line voltage fluctuation when making ac measurements.

ZENER DIODE REFERENCE CIRCUIT

The zener reference circuit consists of a double zener regulated voltage source and is composed of the following parts. (See schematic diagram).

The voltage for the first regulator in the zener package is obtained from a stable 230V dc source. The voltage is dropped to 19V by the current flowing through R501. R501, together with dioaes, SC501 and SC502, compose the zener pre-regulator. 19V DC is supplied to the final zener regulator composed of R504 and SC503 resulting in a highly regulated 9V source across SC503. A precision resistive voltage divider composed of R503, R505 qnd R506 is connected across SC503 to obtain a 1.02 volt sample voltage. For internal calibration of the Model 803R/B this 1.02 volt sample voltage is impressed on the chopper amplifier through switches, S101 and S103. R504 and R505 are potentiometers used to adjust the zener regulated sample voltage for initial calibration.

A sample voltage from the 500V reference supply taken across R35 and R36 in series bucks the voltage obtained from the zener reference circuit resulting in a zero voltage on the chopper when the Model 803R/B has been properly calibrated against the zener reference.

The entire zener reference circuit is housed within an oven which is thermostatically controlled to maintain an oven temperature, 55°C. The heating elements for the oven are two 2 watt, 1 k resistors, R507 and R508. The voltage for these heating resistors is obtained from 117V, 60 cycle at the power transformer primary.

803R/B READING ERROR
HARMONIC DISTORTION

Harmonic	% Distortion	% Error *	
		Max. Positive	Max. Negative
Any even harmonic	.1	.000	
	.5	.001	
	1.0	.005	
	2.0	.020	
Third	.1	.033	.033
	.5	.168	.167
	1.0	.338	.328
	2.0	.687	.667
Fifth	.1	.020	.020
	.5	.101	.099
	1.0	.205	.195
	2.0	.420	.380

* Depends upon phase relationship between harmonic and fundamental for odd harmonics - error can be any value between maximum positive and maximum negative, including zero.

MODEL 803R/B RECALIBRATION INSTRUCTIONS

The calibration of the Model 803R/B should be done in a draft-free area and in an ambient temperature of 72°F ±5°F to insure maximum accuracy under typical laboratory operating conditions. The dc and ac sections of the instrument are calibrated independently, but the dc section must be in calibration before calibrating the ac section. The ground post should be tied to the negative binding post during calibration, and be sure instrument is properly warmed up. (One hour warmup minimum)

DC CALIBRATION

Before attempting dc calibration, the zener reference circuit must be adjust. With the Model 803R/B turned on, turn OPERATE-CAL switch to REF position. By means of a John Fluke Model 801 Differential Voltmeter, adjust the voltage across R506 to 1.0193 volts by means of R505. R504 is used to adjust current through SC503 to 10.000 MA. R504 should not require adjustment except when SC503 is replaced.

To calibrate the basic 500 volts dc range set the 5 voltage dials to 499910, the RANGE switch to the 500V DC position, and the NULL switch to the 1V sensitivity. Adjust the VTVM-10V-1V ZERO potentiometer for zero meter deflection. Apply a known 500 volts dc (accurate to .01% or better) to the input posts of the instrument and adjust the meter to zero by means of the ADJ CAL potentiometer. Turn the OPERATE-CAL switch to the CAL REF position; then hold the OPERATE-CAL switch in the CAL ADJ position, adjusting R-36 for zero reading on the meter. Turn the OPERATE-CAL switch back to the ON position when this step is completed; meter should still read zero. If the ADJ CAL potentiometer is not approximately centered, turn it to a center position and adjust R-31 to zero the meter. Recheck the calibration by setting up the instrument in a normal manner (with the use of the internal Zener Reference) and measuring the known 500 volts.

The 50, 5, and 0.5 volt dc ranges are calibrated after the basic 500 volt range is in calibration. Again set the 5 voltage dials to 499910, the RANGE switch to appropriate dc range, and the NULL switch to the .01V sensitivity. Adjust the .1V - .01V ZERO potentiometer for zero meter deflection. Apply a known voltage equal to the full scale value of the range being calibrated (accurate to .01% or better) to the input posts of the instrument. Adjust the meter to zero by means of R-124 for the 50 volt range, R-126 for the 5 volt range, and R-129 for the 0.5 volt range. The dc section of the instrument is now calibrated.

A very effective independent check of the entire instrument, especially the 5 volt range, consists of measuring the emf of a standard cell which has been recently certified by a standards group. This furnishes a known emf of a value which will read out on all 5 dials in the 5 volt range. The Model 803R/B should read well within ±.03% of the certified value of the known cell.

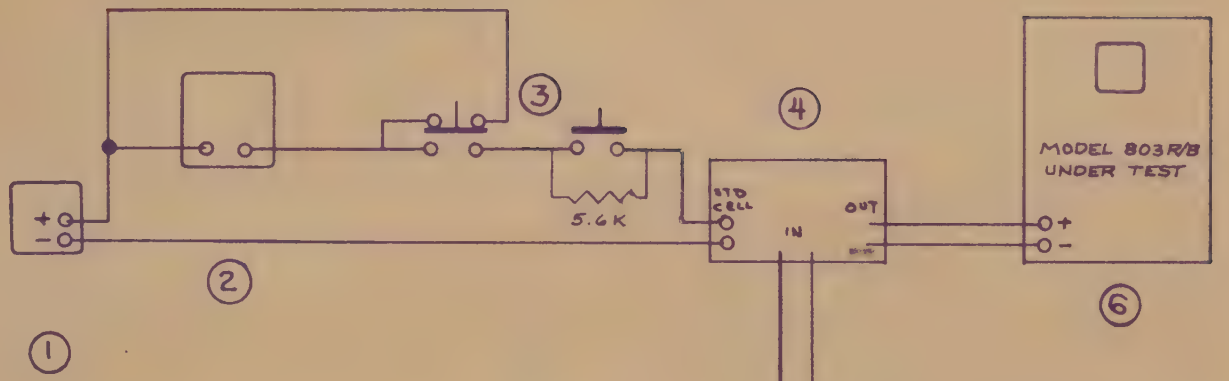
AC CALIBRATION

The ac section is calibrated after the dc section is in calibration. To calibrate the basic 5 volt ac range set the 5 voltage dials to zero, the RANGE switch to the 5V DC position, and the NULL switch to the .01V sensitivity. Adjust the .1V - .01V ZERO potentiometer for zero meter deflection. Turn the NULL switch to the VTVM position and the RANGE switch to the 5V AC position. Place a short across the positive and negative binding posts and turn the NULL switch to the .01V sensitivity. Adjust R-426 for zero meter deflection (a long time constant in associated circuits makes this adjustment more time consuming than normal). Turn the NULL switch to the VTVM position, remove the short from across the binding posts, and turn the 5 voltage dials to 499910. Apply a stable, low distortion (total harmonic distortion of .1% or less) 400 cycle sine wave with a known amplitude of 5 volts (accurate to .05% or better) to the input posts of the instrument. Turn the NULL switch to the .01V sensitivity and adjust the meter to zero by means of R-423. Turn the NULL switch to the VTVM position and apply a known 5 volt, 5,000 cycle sine wave to the instrument. Turn the NULL switch to the .01V sensitivity and adjust the meter to zero by means of C-8.

Turn the NULL switch to the VTVM position, the RANGE switch to the 50V AC position and apply a known 50 volt, 400 cycle sine wave to the instrument. Turn the NULL switch to the .01V sensitivity and adjust the meter to zero by means of R-3. Turn the NULL switch to the VTVM position and apply a known 50 volt, 5,000 cycle sine wave to the instrument. Turn the NULL switch to the .01V sensitivity and adjust the meter to zero by means of C-3.

Turn the NULL switch to the VTVM position, the RANGE switch to the 500V AC position and apply a known 500 volt, 400 cycle sine wave to the instrument. Turn the NULL switch to the .01V sensitivity and adjust the meter to zero by means of R-7. Turn the NULL switch to the VTVM position and apply a know. 500 volt, 5,000 cycle sine wave to the instrument. Turn the NULL switch to the .01V sensitivity and adjust the meter to zero by means of C-5. Turn the NULL switch to the VTVM position. The a-c section of the instrument is now calibrated.

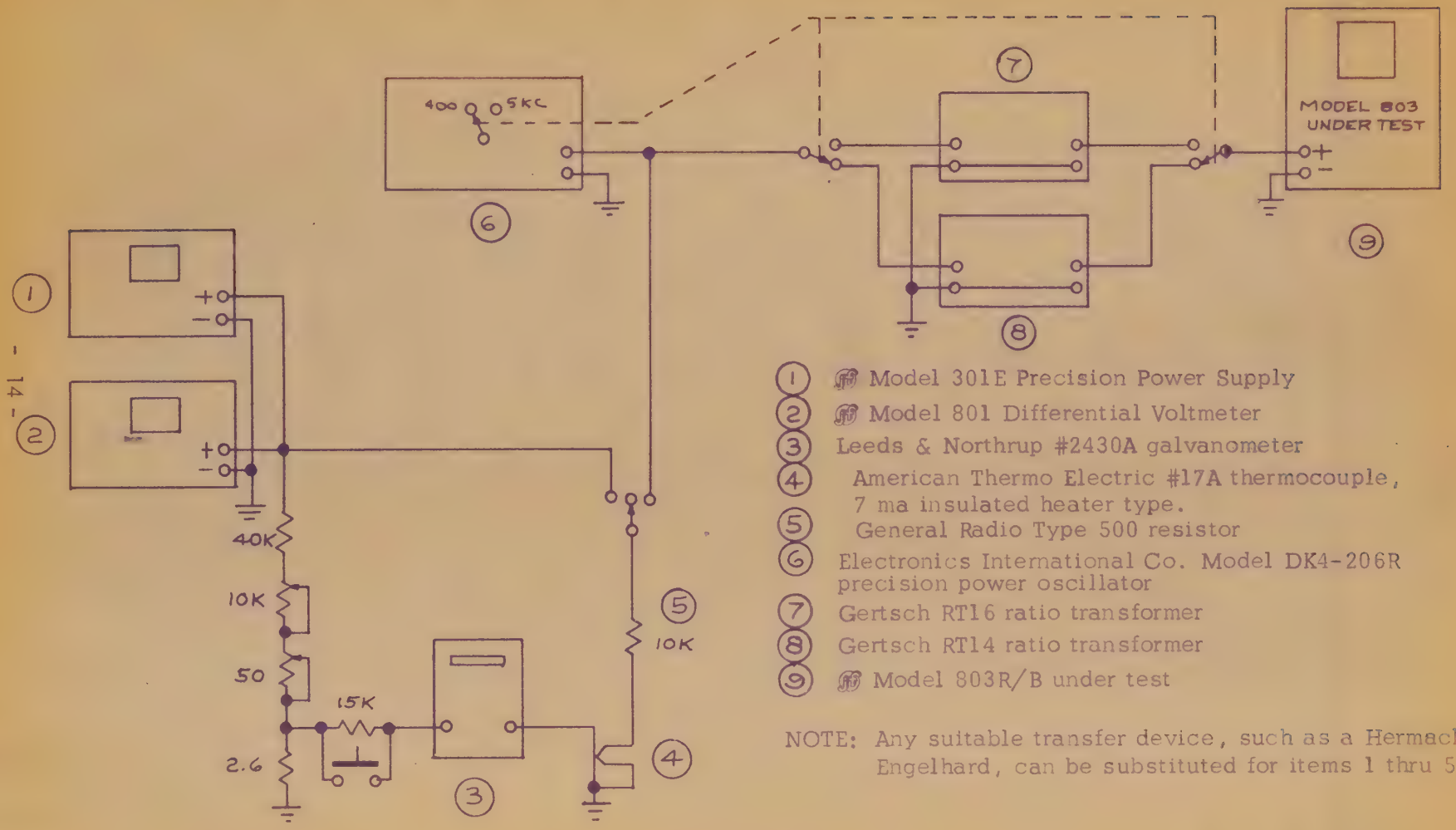
MODEL 803R/B
RECOMMENDED CALIBRATION SET-UP
DC SECTION



1. Eppley #100A standard cell
2. Leeds & Northrup #2430A galvanometer.
3. Momentary push button switches with fine silver contacts.
4. Electro Measurements #X194 precision voltage divider
5. Model 301E Precision Power Supply
6. Model 803R/B under test.

FIGURE 1

MODEL 803R/B
RECOMMENDED CALIBRATION SET-UP
AC SECTION



1. Model 301E Precision Power Supply
2. Model 801 Differential Voltmeter
3. Leeds & Northrup #2430A galvanometer
4. American Thermo Electric #17A thermocouple, 7 ma insulated heater type.
5. General Radio Type 500 resistor
6. Electronics International Co. Model DK4-206R precision power oscillator
7. Gertsch RT16 ratio transformer
8. Gertsch RT14 ratio transformer
9. Model 803R/B under test

NOTE: Any suitable transfer device, such as a Hermach-Engelhard, can be substituted for items 1 thru 5.

FIGURE II

MODEL 803R/B

LIST OF REPLACEABLE PARTS

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
C1A,B,C	Capacitor, electrolytic 20 mfd, 450 v	CE65
C3,5,8	Capacitor, ceramic, variable 0.8 - 4.5 mmf	CA4
C6,6A	Capacitor, ceramic 300 mmf, 600 v	CT13
C7	Capacitor, mylar 0.47 mfd, 600 v	CP21
C9	Capacitor, ceramic 20 mmf, 600 v	CT14
C10, 14	Capacitor, paper 0.1 mfd, 600 v	CP5
C11,302,305	Capacitor, paper 0.1 mfd, 400 v	CP4A
C12	Capacitor, paper 0.01 mfd, 1600 v	CP1
C13	Capacitor, mylar 0.002 mfd, 1000 v	CT8
C101	Capacitor, mylar 1 mfd, 600 v	CP26
C102	Capacitor, polystyrene 1 mfd, 200 v	CO22
C103	Capacitor, metalized mylar 0.47 mfd, 600 v	CP25
C201,202	Capacitor, electrolytic 10/10 mfd, [illegible]	CE70
C203	Capacitor, mylar 0.02 mfd, 600 v	CP18

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
C204,205,206, 207,209	Capacitor, paper 0.047 mfd, 400 v	CP6
C208,311	Capacitor, paper 220 mmf, 600 v	CT1
C210	Capacitor, paper 0.01 mfd, 600 v	CP7
C211,212	Capacitor, mylar 0.22 mfd, 400 v	CP19
C213,214	Capacitor, electrolytic 2 mfd, 50 v	CE31
C301-304	Capacitor, electrolytic 10/10 mfd, 500 v	CE20
C303,405	Capacitor, paper 0.047 mfd, 400 v	CP6A
C307,310	Capacitor, electrolytic 8 mfd, 250 v	CE10
C308	Capacitor, electrolytic 4000 mfd, 15 v	CE23
C401,406	Capacitor, electrolytic 150 mfd, 150 v	CE22
C402,407, 409,411	Capacitor, paper 0.01 mfd, 400 v	CP16
C403,408,413	Capacitor, electrolytic 100 mfd, 6 v	CE21
C404,410	Capacitor, paper 0.47 mfd, 200 v	CP24
C414	Capacitor, ceramic 680 mmf, 600 v	CT3
C415	Capacitor, mylar 5 mfd, 200 v	CP22
C416	Capacitor, metalized paper 2 mfd, 200 v	CP14

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
C417	Capacitor, metalized paper 1 mfd, 200 v	CP17
CH201	Chopper, SPDT 6.3 v, 60 cycles	X100
F1	Fuse, 3 amp.	F3
F101	Fuse, 1/200 A, 250 v	F1/200A
I-103-108	Lamp, neon, NE2E	X40B
J1	Connector, 18 pin female	X150
J2	Connector, 10 pin female	X151
J3	Connector, 24 pin female	X254
J4	Connector, 9 pin male	X149
J5	Connector, 4 pin female	X177
J101	Binding post, red insulators	X219, X217
J102	Binding post, black insulators	X219, X218
J103	Binding post, metal spacer	X219, X220
M101	Meter, 50-0-50 microamp with special scale	M31
P101	Connector, 24 pin male	X255
P102	Connector, 9 pin female	X153
P103	Connector, 4 pin male	X178
R1,8	Resistor, precision metal film 1m, 1%, 1/2 w	DRMF71
R2	Resistor, precision metal film 122 k, 1%, 1/2 w	DRMF61
R3	Resistor, wirewound, variable 5 k, 10%, 1/4 w	P5000TA
R4,5	Resistor, precision metal film 500 k, 1%, 1/2 w	DRMF63

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
R6	Resistor, precision metal film 10 k, 1%, 1/2 w	DRMF51
R7	Resistor, wirewound, variable 500 Ω, 10%, 1/4 w	P500T
R9	Resistor, precision metal film 200 k, 1%, 1/2 w	DRMF62
R10	Resistor, composition 390 Ω, 10%, 1 w	GB3911
R11,314	Resistor, composition 470 k, 10%, 1/2 w	EB4741
R12-19	Resistor, composition 22 k, 10%, 1 w	GB2231
R20	Resistor, deposited carbon 500 k, 1%, 2 w	DR620
R21	Resistor, deposited carbon 144 k, 1%, 1 w	DR67
R22,216,217	Resistor, composition 39 k, 10%, 1 w	GB3931
R23,24,29,213, 214,218,220, 223,308,311, 316,406,413	Resistor, composition 1 m, 10%, 1/2 w	EB1051
R24	Resistor, precision wirewound 149 k, 1/2%, 1 w	PR611
R26,27	Resistor, deposited carbon 300 k, 1%, 1 w	DR614
R28,306	Resistor, deposited carbon 250 k, 1%, 1 w	DR613
R30	Resistor, precision wirewound 320 k, 0.1%, 1 w	PR614
R31	Resistor, wirewound variable 10 k, 10%, 1/4 w	P10KTB
R32	Resistor, precision wirewound 158 k, 0.1%, 1w	PR620

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
R33,34	Resistor, precision wirewound 125 k, 0.1%, 1 w	PR610
R35	Resistor, precision wirewound 509 Ω, 0.1%, 1/2 w	PR37
R36	Resistor, wirewound, variable 5 Ω, 20%, 2 w	P5A
R38,39,40	Resistor, composition 220 k, 10%, 1 w	GB2241
R101	Resistor, composition 270 Ω, 10%, 1 w	GB2711
R102	Resistor, deposited carbon 15 k, 1%, 1/2 w	DB1531
R116	Resistor, deposited carbon 10 k, 1%, 1/2 w	DR51
R103	Resistor, deposited carbon 4.4 m, 1%, 1/2 w	DR74
R104,106	Resistor, deposited carbon 4.5 m, 1%, 1/2 w	DR75
R105	Resistor, deposited carbon 4.99 m, 1%, 1/2 w	DR76
R107	Resistor, deposited carbon 500 k, 1%, 1/2 w	DR618
R108,112	Resistor, deposited carbon 900 k, 1%, 1/2 w	DR622
R109	Resistor, deposited carbon 103.5 k, 1%, 1/2 w	DR63
R110,111	Resistor, deposited carbon 9 m, 1%, 1/2 w	DR78
R113	Resistor, deposited carbon 9.9 m, 1%, 1/2 w	DR79
R114,313,319	Resistor, deposited carbon 90 k, 1%, 1/2 w	DR513

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
R115	Resistor, deposited carbon 9.99 m, 1%, 1/2 w	*DR711
R117,210	Resistor, wirewound, variable 5 k, 10%, 2 w	P5KA
R118,224	Resistor, wirewound, variable 10 k, 10%, 2 w	P10KA
R119	Resistor, wirewound, variable 2 k, 10%, 2 w	P2KB
R120, 121	Resistor, precision wirewound 112.375 k, 0.05%, 1 w	PR615
R122,414	Resistor, composition 27 k, 10%, 1 w	GB2731
R123	Resistor, precision wirewound 28.571 k, 0.05%, 1/2 w	PR515
R124, 126, 129	Resistor, wirewound, variable 500 Ω, 10%, 1/4 w	P500T
R125	Resistor, precision wirewound 2.5317 k, 0.05%, 1/2 w	PR49
R127	Resistor, precision wirewound 22.5 k, 0.1%, 1/2 w	PR513
R128	Resistor, precision wirewound 250.31 Ω, 0.05%, 1/2 w	PR311
R130	Resistor, precision wirewound 24.75 k, 0.1%, 1/2 w	PR514
*R131-136	Resistor, precision wirewound 40 k, 0.02%, 1/2 w, matched	PR512
*R137-147	Resistor, precision wirewound 8 k, 0.05%, 1/2 w, matched	PR48
*R148-158	Resistor, precision wirewound 1.6 k, 0.1%, 1/2 w, matched	PR46
*R159-169	Resistor, precision wirewound 320 Ω, 0.1%, 1/2 w, matched	PR39

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
*R170-179	Resistor, precision wirewound 64 Ω, 0.1%, 1/2 w, matched	PR24
R180, 181, 303, 305, 320, 321	Resistor, composition 150 k, 10%, 1/2 w	EB1541
R182, 430	Resistor, composition 1 k, 10%, 1 w	GB1021
R201, 202	Resistor, composition 56 Ω, 10%, 1 w	GB5601
R209	Resistor, composition 4.7 k, 10%, 1 w	GB4721
R211, 212	Resistor, deposited carbon 8.2 k, 1%, 1/2 w	DR411
R215, 324, 325	Resistor, composition 10 k, 10%, 1 w	GB1031
R219, 228, 404, 405	Resistor, composition 2.2 m, 10%, 1/2 w	EB2251
R221	Resistor, deposited carbon 2.2 m, 1%, 1/2 w	DR73
R222, 410, 411	Resistor, composition 10 m, 10%, 1/2 w	EB1061
R225	Resistor, deposited carbon 5 k, 1%, 1/2 w	DR49
R226, 227, 304	Resistor, composition 220 k, 10%, 1/2 w	EB2241
R229, 230, 318	Resistor, deposited carbon 40 k, 1%, 1/2 w	DR57'
R232	Resistor, power 5 k, 5 w	R5KWA
R301, 302	Resistor, composition 10 Ω, 10%, 1 w	GB1001
R307	Resistor, deposited carbon 125 k, 1%, 1/2 w	DR629

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
R309,310	Resistor, composition 680 k, 10%, 1/2 w	EB6841
R312	Resistor, deposited carbon 45 k, 1%, 1 w	DR58
R315	Resistor, composition 100 k, 10%, 1/2 w	EB1041
R317	Resistor, deposited carbon 100 k, 1%, 1/2 w	DR61
R322	Resistor, deposited carbon 3.89 k, 1%, 1/2 w	DR414
R323,424,425	Resistor, deposited carbon 50 k, 1%, 1/2 w	DR59
R326	Resistor, composition 15 k, 10%, 1 w	GB1531
R327	Resistor, wirewound 7.5 Ω, 5%, 5 w	R7.5W
R328	Resistor, composition 10 k, 10%, 1/2 w	EB1031
R401,407,408	Resistor, composition 3.3 k, 10%, 1 w	GB3321
R402	Resistor, composition 1.5 k, 10%, 1 w	GB1521
R403,409,427	Resistor, composition 220 Ω, 10%, 1/2 w	EB2211
R412	Resistor, composition 360 Ω, 5%, 1 w	GB3615
R415	Resistor, composition 560 Ω, 10%, 1/2 w	EB5611
R416	Resistor, composition 100 Ω, 10%, 1/2 w	EB1011
R417-419	Resistor, composition 33 k, 10%, 1 w	GB3331

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
R420,421	Resistor, precision metal film 22 k, 1%, 1/2 w	DRMF52
R422	Resistor, precision metal film 2.4 k, 1%, 1/2 w	DRMF42
R423	Resistor, wirewound, variable 100 Ω, 10%, 1/4 w	P100T
R426	Resistor, variable wirewound 5 k, 10%, 1/4 w	P5000T
R428,429	Resistor, composition 10 Ω, 10%, 1 w	GB1001
R501	Resistor, power 10 k, 1%, 7 w	R10KWB
R502	Resistor, wirewound 750 Ω, 0.1%, 1/2 w	PR312
R503	Resistor, wirewound 8.25 k, 0.1%, 1/2 w	PR410
R504,505	Resistor, variable 500 Ω, 20%, 2 w	P500T
R506	Resistor, wirewound 1.02 k, 0.1%, 1/2 w	PR41
R507,508	Resistor, composition 1 k, 10%, 2 w	HB1021
S101	Switch, rotary, 3 pole, 4 position Rack Model 803	803R-804
S102	Switch, rotary, 10 pole, 7 position	SR39
S103	Switch, rotary, 6 pole, 5 position	SR29
S104	Switch, rotary, 2 pole, 5 position	SR40
S105,106,107	Switch, rotary, 2 pole, 10 position	SR41
S108	Switch, rotary, 2 pole, 11 position	SR42
SC203,204	Diode, silicon, 400 PIV, 0.3 A	2E4

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
SC301, 302	Rectifier, silicon, 50 v, 1 amp.	RE8
SC201, 202, 303	Diode, silicon, 600 v, PIV, 0.5 amp	RE10
SC401, 402	Rectifier, silicon, 40 v, 2 ma	RE7
SC501, 502	Zener diode 1N2163A	1N2163A
SC503	Diode	RE19
T1	Transformer assembly, harnessed Rack model 803R	803R-611
TR1	Transistor, power	2N301W
TR301, 302	Transistor, NPN junction	2N214
V1	Vacuum tube Rectifier, 5AR4	5AR4
V2, 305	Vacuum tube Pentode, 6AQ5A	6AQ5A
V3	Vacuum tube Pentode, 6AU6	6AU6
V4, 202, 308	Vacuum tube Voltage regulator, OA2	OA2
V5, 204, 404	Vacuum tube Duo triode, 12AU7	12AU7
V6, 7, 307	Vacuum tube Voltage reference, OG3	OG3
V8, 206, 304	Vacuum tube Duo triode, 12AX7	12AX7
V201	Vacuum tube Current regulator, 9-7	9-7
V203	Vacuum tube Voltage regulator, OB2	OB2
V205	Vacuum tube Triode, 6C4	6C4

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
V301	Vacuum tube Rectifier, 6X4	6X4
V302	Vacuum tube Beam power, 5881	5881
V303,306	Vacuum tube Triode-Pentode, 6AW8	6AW8
V310	Lamp, neon NE2E	NE2E
V401-403	Vacuum tube Pentode, 6DK6	6DK6
	Knob, 1-1/2" with pointer	X234
	Knob, 1-1/2" without pointer	X207
	Knob, 1" with pointer	X231
	Dial, voltage readout	D2
	Bezel, readout hole	803-234
	Lens, plexiglass	803-235
	Handle, assembly	X373
	Fuse holder	X12
	Washer, insulating, flat	X93
	Washer, insulating, shoulder	X93A
	Thermostat (Zener oven)	X342A

*These resistors are factory matched for each instrument. When ordering, specify instrument serial number for each resistor ordered.

WARRANTY

The JOHN FLUKE MFG. CO., INC. warrants each instrument manufactured by them to be free from defects in material and workmanship. Their obligation under this Warranty is limited to servicing or adjusting an instrument returned to the factory for that purpose, and to making good at the factory any part or parts thereof; except tubes, fuses, choppers and batteries, which shall, within one year after making delivery to the original purchaser, be returned by the original purchaser with transportation charges prepaid, and which upon their examination shall disclose to their satisfaction to have been thus defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before work is started, if requested.

If any fault develops, the following steps should be taken.

1. Notify the John Fluke Mfg. Co., Inc., giving full details of the difficulty, and include the Model number, type number, and serial number. On receipt of this information, service data or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the Warranty.

SHIPPING

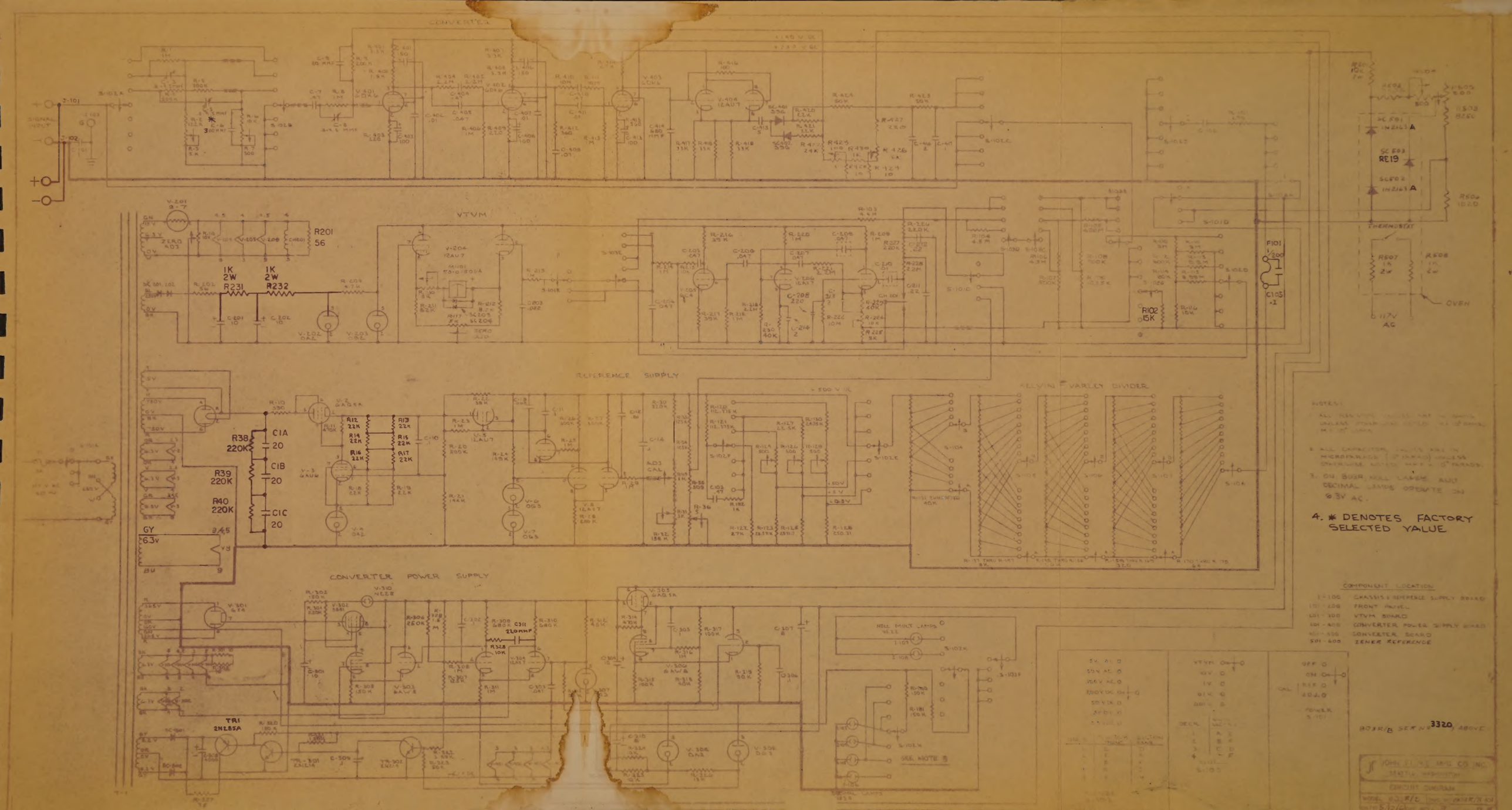
All shipments of John Fluke Mfg. Co., Inc. instruments should be made via Railway Express prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be thoroughly inspected immediately upon receipt. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to John Fluke Mfg. Co., Inc. Upon receipt of this report you will be advised of the disposition of the equipment for repair or replacement. Include the model number, type number, and serial number when referring to this instrument for any reason.

The John Fluke Mfg. Co., Inc. will be happy to answer all application questions which will enhance your use of this instrument. Please address your requests to:

JOHN FLUKE MFG. CO., INC., P. O. BOX 7428, SEATTLE 33, WASHINGTON



NOTES:

1. ALL RESISTORS VALUES ARE IN OHMS UNLESS OTHERWISE NOTED K=1000 M=1,000,000
2. ALL CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE NOTED P=MMF
3. ON DUAL NULL LAMPS AND DECIMAL LAMPS OPERATE ON 6.3V AC.
4. * DENOTES FACTORY SELECTED VALUE

COMPONENT LOCATION

1-100	CHASSIS & REFERENCE SUPPLY BOARD
101-200	FRONT PANEL
201-300	VTVM BOARD
301-400	CONVERTER POWER SUPPLY BOARD
401-500	CONVERTER BOARD
501-600	ZENER REFERENCE

BOX B SERIES 3320 ABOVE

JOHN FLUKE MFG CO INC
SEATTLE, WASHINGTON
CIRCUIT DIAGRAM
MODEL 301 B/C